§§ 80.43–80.44 [Reserved]

§ 80.45 Complex emissions model.

(a) *Definition of terms.* For the purposes of this section, the following definitions shall apply:

Target fuel = The fuel which is being evaluated for its emissions performance using the complex model
OXY = Oxygen content of the target fuel in terms of weight percent
SUL = Sulfur content of the target fuel in terms of parts per million by weight
RVP = Reid Vapor Pressure of the target fuel in terms of pounds per square inch
E200 = 200 °F distillation fraction of the target fuel in terms of volume percent
E300 = 300 °F distillation fraction of the target fuel in terms of volume percent
ARO = Aromatics content of the target fuel in terms of volume percent
BEN = Benzene content of the target fuel in terms of volume percent
OLE = Olefins content of the target fuel in terms of volume percent
MTB = Methyl tertiary butyl ether content of the target fuel in terms of weight percent oxygen
ETB = Ethyl tertiary butyl ether content of the target fuel in terms of weight percent oxygen
TAM = Tertiary amyl methyl ether content of the target fuel in terms of weight percent oxygen
ETH = Ethanol content of the target fuel in terms of weight percent oxygen
exp = The function that raises the number e (the base of the natural logarithm) to the power in its domain
Phase I = The years 1995–1999
Phase II = Year 2000 and beyond

(b) *Weightings and baselines for the complex model.* (1) The weightings for normal and higher emitters (w_1 and w_2, respectively) given in table 1 shall be used to calculate the exhaust emission performance of any fuel for the appropriate pollutant and Phase:

TABLE 1—NORMAL AND HIGHER EMITTER WEIGHTINGS FOR EXHAUST EMISSIONS

	Phase I		Phase II	
	VOC & toxics	NO_X	VOC & toxics	NO_X
Normal Emitters (w_1)	0.52	0.82	0.444	0.738
Higher Emitters (w_2)	0.48	0.18	0.556	0.262

(2) The following properties of the baseline fuels shall be used when determining baseline mass emissions of the various pollutants:

TABLE 2—SUMMER AND WINTER BASELINE FUEL PROPERTIES

Fuel property	Summer	Winter
Oxygen (wt %)	0.0	0.0
Sulfur (ppm)	339	338
RVP (psi)	8.7	11.5
E200 (%)	41.0	50.0
E300 (%)	83.0	83.0
Aromatics (vol %)	32.0	26.4
Olefins (vol %)	9.2	11.9
Benzene (vol %)	1.53	1.64

(3) The baseline mass emissions for VOC, NO_X and toxics given in tables 3, 4 and 5 of this paragraph (b)(3) shall be used in conjunction with the complex model during the appropriate Phase and season:

TABLE 3—BASELINE EXHAUST EMISSIONS

Exhaust pollutant	Phase I		Phase II	
	Summer (mg/mile)	Winter (mg/mile)	Summer (mg/mile)	Winter (mg/mile)
VOC	446.0	660.0	907.0	1341.0
NO_x	660.0	750.0	1340.0	1540.0
Benzene	26.10	37.57	53.54	77.62
Acetaldehyde	2.19	3.57	4.44	7.25
Formaldehyde	4.85	7.73	9.70	15.34
1,3-Butadiene	4.31	7.27	9.38	15.84
POM	1.50	2.21	3.04	4.50

TABLE 4—BASELINE NON-EXHAUST EMISSIONS (SUMMER ONLY)

Non-exhaust pollutant	Phase I		Phase II	
	Region 1 (mg/mile)	Region 2 (mg/mile)	Region 1 (mg/mile)	Region 2 (mg/mile)
VOC	860.48	769.10	559.31	492.07
Benzene	9.66	8.63	6.24	5.50

TABLE 5—TOTAL BASELINE VOC, NO_X AND TOXICS EMISSIONS

Pollutant	Summer (mg/mile)				Winter (mg/mile)			
	Phase I		Phase II		Phase I		Phase II	
	Region 1	Region 2	Region 1	Region 2	Region 1	Region 2	Region 1	Region 2
NO_X	660.0	660.0	1340.0	1340.0	750.0	750.0	1540.0	1540.0
VOC	1306.5	1215.1	1466.3	1399.1	660.0	660.0	1341.0	1341.0
Toxics	48.61	47.58	86.34	85.61	58.36	58.36	120.55	120.55

(c) *VOC performance.* (1) The exhaust VOC emissions performance of gasolines shall be given by the following equations:

$$VOCE = VOC(b)+(VOC(b)\times Y_{voc}(t)/100)$$
$$Y_{voc}(t) = [(w_1\times N_v)+(w_2\times H_v)-1]\times 100$$

where

VOCE = Exhaust VOC emissions in milligrams/mile

$Y_{voc}(t)$ = Exhaust VOC performance of the target fuel in terms of percentage change from baseline

VOC(b) = Baseline exhaust VOC emissions as defined in paragraph (b)(2) of this section for the appropriate Phase and season

N_v = [exp $v_1(t)$]/[exp $v_1(b)$]

H_v = [exp $v_2(t)$]/[exp $v_2(b)$]

w_1 = Weighting factor for normal emitters as defined in paragraph (b)(1) of this section for the appropriate Phase

w_2 = Weighting factor for higher emitters as defined in paragraph (b)(1) of this section for the appropriate Phase

$v_1(t)$ = Normal emitter VOC equation as defined in paragraph (c)(1)(i) of this section, evaluated using the target fuel's properties subject to paragraphs (c)(1) (iii) and (iv) of this section

$v_2(t)$ = Higher emitter VOC equation as defined in paragraph (c)(1)(ii) of this section, evaluated using the target fuel's properties subject to paragraphs (c)(1) (iii) and (iv) of this section

$v_1(b)$ = Normal emitter VOC equation as defined in paragraph (c)(1)(i) of this section, evaluated using the base fuel's properties

$v_2(b)$ = Higher emitter VOC equation as defined in paragraph (c)(1)(ii) of this section, evaluated using the base fuel's properties

(i) *Consolidated VOC equation for normal emitters.*

$$v_1 = (-0.003641 \times OXY) + (0.0005219 \times SUL) + (0.0289749 \times RVP) + (-0.014470 \times E200) + (-0.068624 \times E300) + (0.0323712 \times ARO) + (-0.002858 \times OLE) + (0.0001072 \times E2002) + (0.0004087 \times E3002) + (-0.0003481 \times ARO \times E300)$$

(ii) *VOC equation for higher emitters.*

$$v_2 = (-0.003626 \times OXY) + (-5.40X10^{-5} \times SUL) + (0.043295 \times RVP) + (-0.013504 \times E200) + (-0.062327 \times E300) + (0.0282042 \times ARO) + (-0.002858 \times OLE) + (0.000106 \times E200^2) + (0.000408 \times E300^2) + (-0.000287 \times ARO \times E300)$$

(iii) *Flat line extrapolations.* (A) During Phase I, fuels with E200 values greater than 65.83 percent shall be evaluated with the E200 fuel parameter set equal to 65.83 percent when calculating $Y_{voc}(t)$ and VOCE using the equations described in paragraphs (c)(1) (i) and (ii) of this section. Fuels with E300 values greater than E300* (calculated using the equation E300* = 80.32+[0.390×ARO]) shall be evaluated with the E300 parameter set equal to E300* when calculating VOCE using the equations described in paragraphs (c)(1) (i) and (ii) of this section. For E300* values greater than 94, the linearly extrapolated model presented in paragraph (c)(1)(iv) of this section shall be used.

(B) During Phase II, fuels with E200 values greater than 65.52 percent shall be evaluated with the E200 fuel parameter set equal to 65.52 percent when calculating VOCE using the equations described in paragraphs (c)(1) (i) and (ii) of this section. Fuels with E300 values greater than E300* (calculated using the equation E300* = 79.75+[0.385 × ARO]) shall be evaluated with the E300 parameter set equal to E300* when calculating VOCE using the equations described in paragraphs (c)(1) (i) and (ii) of this section. For E300* values greater than 94, the linearly extrapolated model presented in paragraph (c)(1)(iv) of this section shall be used.

(iv) *Linear extrapolations.* (A) The equations in paragraphs (c)(1) (i) and (ii) of this section shall be used within the allowable range of E300, E200, and ARO for the appropriate Phase, as defined in table 6:

TABLE 6—ALLOWABLE RANGES OF E200, E300, AND ARO FOR THE EXHAUST VOC EQUATIONS IN PARAGRAPHS (c)(1)(i) AND (ii) OF THIS SECTION

Fuel parameter	Phase I		Phase II	
	Lower limit	Higher limit	Lower limit	Higher limit
E200 ...	33.00	65.83	33.00	65.52
E300 ...	72.00	Variable[1]	72.00	Variable[2]
ARO	18.00	46.00	18.00	46.00

[1] Higher E300 limit = lower of 94.0 or 80.32+[0.390×(ARO)].
[2] Higher E300 limit = lower of 94.0 or 79.75+[0.385×(ARO)].

(B) For fuels with E200, E300 and/or ARO levels outside the ranges defined in table 6, $Y_{VOC}(t)$ shall be defined:

(*1*) For Phase I:

$$Y_{VOC}(t) = 100\% \times 0.52 \times [\exp(v_1(et)) / \exp(v_1(b)) - 1] + 100\% \times 0.48 \times [\exp(v_2(et)) / \exp(v_2(b)) - 1] + \{100\% \times 0.52 \times [\exp(v^1(et)) / \exp(v_1(b))] \times [\{[(0.0002144 \times E200_{et}) - 0.014470] \times \Delta E200\} + \{[(0.0008174 \times E300_{et}) - 0.068624 - (0.000348 \times ARO_{et})] \times \Delta E300\} + \{[(-0.000348 \times E300_{et}) + .0323712] \times \Delta ARO\}]\} + \{100\% \times 0.48 \times [\exp(v_1(et)) / \exp(v_2(b))\}] \times [\{[(0.000212 \times E200_{et}) - 0.01350] \times \Delta E200\} + \{[(0.000816 \times E300_{et}) - 0.06233 - (0.00029 \times ARO_{et})] \times \Delta E300\square + \{[(-0.00029 \times E300_{2et}) + 0.028204] \times \Delta ARO\}]\}$$

(*2*) For Phase II:

$$Y_{VOC}(t) = 100\% \times 0.444 \times [\exp(v_1(et)) / \exp(v_1(b)) - 1] + 100\% \times 0.556 \times [\exp(v_2(et)) / \exp(v_2(b)) - 1] + \{100\% \times 0.444 \times [\exp(v_1(et)) / \exp(v_1(b))] \times [\{[(0.0002144 \times E200_{et}) - 0.014470] \times \Delta E200\} + \{[(0.0008174 \times E300_{et}) - 0.068624 - (0.000348 \times ARO_{et})] \times \Delta E300\} + \{[(-0.000348 \times E300_{et}) + 0.0323712] \times \Delta ARO\}]\} + \{100\% \times 0.556 \times [\exp(v_2(et)) / \exp(v_2(b))] \times [\{[(0.000212 \times E200_{et}) - 0.01350] \times \Delta E200\} + \{[(0.000816 \times E300_{et}) - 0.06233 - (0.00029 \times ARO_{et})] \times \Delta E300\} + \{[(-0.00029 \times E300_{et}) + 0.028204] \times \Delta ARO\}]\}$$

(C) During Phase I, the ‘‘edge target’’ fuel shall be identical to the target fuel for all fuel parameters, with the following exceptions:

(*1*) If the E200 level of the target fuel is less than 33 volume percent, then the E200 value for the ‘‘edge target’’ fuel shall be set equal to 33 volume percent.

(*2*) If the aromatics level of the target fuel is less than 18 volume percent, then the ARO value for the ‘‘edge target’’ fuel shall be set equal to 18 volume percent.

(*3*) If the aromatics level of the target fuel is greater than 46 volume percent, then the ARO value for the ‘‘edge target’’ fuel shall be set equal to 46 volume percent.

(*4*) If the E300 level of the target fuel is less than 72 volume percent, then the E300 value for the ‘‘edge target’’ fuel shall be set equal to 72 volume percent.

(*5*) If the E300 level of the target fuel is greater than 95 volume percent, then the E300 value of the target fuel shall be set equal to 95 volume percent for the purposes of calculating VOC emissions with the Phase I equation given in paragraph (c)(1)(iv)(B) of this section.

(*6*) If [80.32+(0.390×ARO)] exceeds 94 for the target fuel, then the E300 value for the ‘‘edge target’’ fuel shall be set equal to 94 volume percent.

(*7*) If the E200 level of the target fuel is less than 33 volume percent, then ΔE200 shall be set equal to (E200−33 volume percent).

(*8*) If the E200 level of the target fuel equals or exceeds 33 volume percent, then ΔE200 shall be set equal to zero.

(*9*) If the aromatics level of the target fuel is less than 18 volume percent, then ΔARO shall be set equal to (ARO−18 volume percent). If the aromatics level of the target fuel is less than 10 volume percent, then ΔARO shall be set equal to −8 volume percent.

(*10*) If the aromatics level of the target fuel is greater than 46 volume percent, then ΔARO shall be set equal to (ARO−46 volume percent).

(*11*) If neither of the conditions established in paragraphs (c)(1)(iv)(C)(*9*) and (*10*) of this section are met, then ΔARO shall be set equal to zero.

(*12*) If the E300 level of the target fuel is less than 72 percent, then ΔE300 shall be set equal to (E300−72 percent).

(*13*) If the E300 level of the target fuel is greater than 94 volume percent and [80.32+(0.390xARO)] also is greater than 94, then ΔE300 shall be set equal to (E300−94 volume percent). If the E300 level of the target fuel is greater than 95 volume percent and [80.32+(0.390×ARO)] also is greater than 94, then ΔE300 shall be set equal to 1 volume percent.

(*14*) If neither of the conditions established in paragraphs (c)(1)(iv)(C)(*12*) and (*13*) of this section are met, then $\Delta E300$ shall be set equal to zero.

(D) During Phase II, the ‘‘edge target’’ fuel is identical to the target fuel for all fuel parameters, with the following exceptions:

(*1*) If the E200 level of the target fuel is less than 33 volume percent, then the E200 value for the ‘‘edge target’’ fuel shall be set equal to 33 volume percent.

(*2*) If the aromatics level of the target fuel is less than 18 volume percent, then the ARO value for the ‘‘edge target’’ fuel shall be set equal to 18 volume percent.

(*3*) If the aromatics level of the target fuel is greater than 46 volume percent, then the ARO value for the ‘‘edge target’’ fuel shall be set equal to 46 volume percent.

(*4*) If the E300 level of the target fuel is less than 72 volume percent, then the E300 value for the ‘‘edge target’’ fuel shall be set equal to 72 volume percent.

(*5*) If the E300 level of the target fuel is greater than 95 volume percent, then the E300 value of the target fuel shall be set equal to 95 volume percent for the purposes of calculating VOC emissions with the Phase II equation given in paragraph (c)(1)(iv)(B) of this section.

(*6*) If $[79.75+(0.385\times ARO)]$ exceeds 94 for the target fuel, then the E300 value for the ‘‘edge target’’ fuel shall be set equal to 94 volume percent.

(*7*) If the E200 level of the target fuel is less than 33 volume percent, then $\Delta E200$ shall be set equal to $(E200-33$ volume percent).

(*8*) If the E200 level of the target fuel equals or exceeds 33 volume percent, then $\Delta E200$ shall be set equal to zero.

(*9*) If the aromatics level of the target fuel is less than 18 volume percent and greater than or equal to 10 volume percent, then ΔARO shall be set equal to $(ARO-18$ volume percent). If the aromatics level of the target fuel is less than 10 volume percent, then ΔARO shall be set equal to -8 volume percent.

(*10*) If the aromatics level of the target fuel is greater than 46 volume percent, then ΔARO shall be set equal to $(ARO - 46$ volume percent).

(*11*) If neither of the conditions established in paragraphs (c)(1)(iv)(D)(9) and (10) of this section are met, then ΔARO shall be set equal to zero.

(*12*) If the E300 level of the target fuel is less than 72 percent, then $\Delta E300$ shall be set equal to $(E300 - 72$ percent).

(*13*) If the E300 level of the target fuel is greater than 94 volume percent and $(79.75 + (0.385 \times ARO))$ also is greater than 94, then $\Delta E300$ shall be set equal to $(E300 - 94$ volume percent). If the E300 level of the target fuel is greater than 95 volume percent and $(79.75 + (0.385 \times ARO))$ also is greater than 94, then ‘‘E300 shall be set equal to 1 volume percent.

(2) The winter exhaust VOC emissions performance of gasolines shall be given by the equations presented in paragraph (c)(1) of this section with the RVP value set to 8.7 psi for both the baseline and target fuels.

(3) The nonexhaust VOC emissions performance of gasolines in VOC Control Region 1 shall be given by the following equations, where:

VOCNE1 = Total nonexhaust emissions of volatile organic compounds in VOC Control Region 1 in grams per mile

VOCDI1 = Diurnal emissions of volatile organic compounds in VOC Control Region 1 in grams per mile

VOCHS1 = Hot soak emissions of volatile organic compounds in VOC Control Region 1 in grams per mile

VOCRL1 = Running loss emissions of volatile organic compounds in VOC Control Region 1 in grams per mile

VOCRF1 = Refueling emissions of volatile organic compounds in VOC Control Region 1 in grams per mile

(i) During Phase I:

$$VOCNE1 = VOCDI1+VOCHS1+VOCRL1+VOCRF1$$

$$VOCDI1 = [0.00736 \times (RVP^2)]-[0.0790 \times RVP]+0.2553$$

$$VOCHS1 = [0.01557 \times (RVP^2)]-[0.1671 \times RVP]+0.5399$$

$$VOCRL1 = [0.00279 \times (RVP^2)]+[0.1096 \times RVP] -0.7340$$

$$VOCRF1 = [0.006668 \times RVP]-0.0180$$

(ii) During Phase II:

$$VOCNE1 = VOCDI1+VOCHS1+VOCRL1+VOCRF1$$

$$VOCDI1 = [0.007385 \times (RVP^2)]-[0.08981 \times RVP]+0.3158$$

$$VOCHS1 = [0.006654 \times (RVP^2)] -[0.08094 \times RVP]+0.2846$$

$VOCRL1 = [0.017768 \times (RVP^2)] - [0.18746 \times RVP] + 0.6146$

$VOCRF1 = [0.004767 \times RVP] + 0.011859$

(4) The nonexhaust VOC emissions performance of gasolines in VOC Control Region 2 shall be given by the following equations, where:

VOCNE2 = Total nonexhaust emissions of volatile organic compounds in VOC Control Region 2 in grams per mile

VOCDI2 = Diurnal emissions of volatile organic compounds in VOC Control Region 2 in grams per mile

VOCHS2 = Hot soak emissions of volatile organic compounds in VOC Control Region 2 in grams per mile

VOCRL2 = Running loss emissions of volatile organic compounds in VOC Control Region 2 in grams per mile

VOCRF2 = Refueling emissions of volatile organic compounds in VOC Control Region 2 in grams per mile

(i) During Phase I:

$VOCNE2 = VOCDI2 + VOCHS2 + VOCRL2 + VOCRF2$

$VOCDI2 = [0.006818 \times (RVP^2)] - [0.07682 \times RVP] + 0.2610$

$VOCHS2 = [0.014421 \times (RVP^2)] - [0.16248 \times RVP] + 0.5520$

$VOCRL2 = [0.016255 \times (RVP^2)] - [0.1306 \times RVP] + 0.2963$

$VOCRF2 = [0.006668 \times RVP] - 0.0180$

(ii) During Phase II:

$VOCNE2 = VOCDI2 + VOCHS2 + VOCRL2 + VOCRF2$

$VOCDI2 = [0.004775 \times (RVP^2)] - [0.05872 \times RVP] + 0.21306$

$VOCHS2 = [0.006078 \times (RVP^2)] - [0.07474 \times RVP] + 0.27117$

$VOCRL2 = [0.016169 \times (RVP^2)] - [0.17206 \times RVP] + 0.56724$

$VOCRF2 = [0.004767 \times RVP] + 0.011859$

(5) Winter VOC emissions shall be given by VOCE, as defined in paragraph (c)(2) of this section, using the appropriate baseline emissions given in paragraph (b)(3) of this section. Total nonexhaust VOC emissions shall be set equal to zero under winter conditions.

(6) *Total VOC emissions.* (i) Total summer VOC emissions shall be given by the following equations:

$VOCS1 = (VOCE/1000) + VOCNE1$

$VOCS2 = (VOCE/1000) + VOCNE2$

VOCS1 = Total summer VOC emissions in VOC Control Region 1 in terms of grams per mile

VOCS2 = Total summer VOC emissions in VOC Control Region 2 in terms of grams per mile

(ii) Total winter VOC emissions shall be given by the following equations:

$VOCW = (VOCE/1000)$

VOCW = Total winter VOC emissions in terms of grams per mile

(7) *Phase I total VOC emissions performance.* (i) The total summer VOC emissions performance of the target fuel in percentage terms from baseline levels shall be given by the following equations during Phase I:

$VOCS1\% = [100\% \times (VOCS1 - 1.306 \text{ g/mi})]/(1.306 \text{ g/mi})$

$VOCS2\% = [100\% \times (VOCS2 - 1.215 \text{ g/mi})]/(1.215 \text{ g/mi})$

VOC1% = Percentage change in VOC emissions from baseline levels in VOC Control Region 1

VOC2% = Percentage change in VOC emissions from baseline levels in VOC Control Region 2

(ii) The total winter VOC emissions performance of the target fuel in percentage terms from baseline levels shall be given by the following equations during Phase I:

$VOCW\% = [100\% \times (VOCW - 0.660 \text{ g/mi})]/(0.660 \text{ g/mi})$

VOCW% = Percentage change in winter VOC emissions from baseline levels

(8) *Phase II total VOC emissions performance.* (i) The total summer VOC emissions performance of the target fuel in percentage terms from baseline levels shall be given by the following equations during Phase II:

$VOCS1\% = [100\% \times (VOCS1 - 1.4663 \text{ g/mi})]/(1.4663 \text{ g/mi})$

$VOCS2\% = [100\% \times (VOCS2 - 1.3991 \text{ g/mi})]/(1.3991 \text{ g/mi})$

(ii) The total winter VOC emissions performance of the target fuel in percentage terms from baseline levels shall be given by the following equation during Phase II:

$VOCW\% = [100\% \times (VOC - 1.341 \text{ g/mi})] / (1.341 \text{ g/mi})$

(d) *NO_X performance.* (1) The summer NO_X emissions performance of gasolines shall be given by the following equations:

$NO_X = NO_X(b)+[NO_X(b) \times Y(t)/100]$
$Y_{NOX}(t) = \beta(w_1 \times N_n)+(w_2 \times H_n) - 1\alpha \times 100$

where

NO_X = NO_X emissions in milligrams/mile
$Y_{NOx}(t)$ = NO_X performance of target fuel in terms of percentage change from baseline
$NO_X(b)$ = Baseline NO_X emissions as defined in paragraph (b)(2) of this section for the appropriate phase and season
$N_n = \exp n_1(t)/\exp n_1(b)$
$H_n = \exp n_2(t)/\exp n_2(b)$
w_1 = Weighting factor for normal emitters as defined in paragraph (b)(1) of this section for the appropriate Phase
w_2 = Weighting factor for higher emitters as defined in paragraph (b)(1) of this section for the appropriate Phase
$n_1(t)$ = Normal emitter NO_X equation as defined in paragraph (d)(1)(i) of this section, evaluated using the target fuel's properties subject to paragraphs (d)(1)(iii) and (iv) of this section
$n_2(t)$ = Higher emitter NO_X equation as defined in paragraph (d)(1)(ii) of this section, evaluated using the target fuel's properties subject to paragraphs (d)(1)(iii) and (iv) of this section
$n_1(b)$ = Normal emitter NO_X equation as defined in paragraph (d)(1)(i) of this section, evaluated using the base fuel's properties
$n_2(b)$ = Higher emitter NO_X equation as defined in paragraph (d)(1)(ii) of this section, evaluated using the base fuel's properties

(i) *Consolidated equation for normal emitters.*

$$n_1 = (0.0018571 \times OXY) + (0.0006921 \times SUL) + (0.0090744 \times RVP) + (0.0009310 \times E200)+ (0.0008460 \times E300)+ (0.0083632 \times ARO) + (-0.002774 \times OLE) + (-6.63X10^{-7} \times SUL^2) + (-0.000119 \times ARO^2) + (0.0003665 \times OLE^2)$$

(ii) *Equation for higher emitters.*

$$n_2 = (-0.00913 \times OXY) + (0.000252 \times SUL) + (-0.01397 \times RVP) + (0.000931 \times E200) + (-0.00401 \times E300) + (0.007097 \times ARO) + (-0.00276 \times OLE) + (0.0003665 \times OLE^2) + (-7.995x10^{-5} \times ARO^2)$$

(iii) *Flat line extrapolations.* (A) During Phase I, fuels with olefin levels less than 3.77 volume percent shall be evaluated with the OLE fuel parameter set equal to 3.77 volume percent when calculating NO_X performance using the equations described in paragraphs (d)(1)(i) and (ii) of this section. Fuels with aromatics levels greater than 36.2 volume percent shall be evaluated with the ARO fuel parameter set equal to 36.2 volume percent when calculating NO_X performance using the equations described in paragraphs (d)(1)(i) and (ii) of this section.

(B) During Phase II, fuels with olefin levels less than 3.77 volume percent shall be evaluated with the OLE fuel parameter set equal to 3.77 volume percent when calculating NO_X performance using the equations described in paragraphs (d)(1)(i) and (ii) of this section. Fuels with aromatics levels greater than 36.8 volume percent shall be evaluated with the ARO fuel parameter set equal to 36.8 volume percent when calculating NO_X performance using the equations described in paragraphs (d)(1)(i) and (ii) of this section.

(iv) *Linear extrapolations.* (A) The equations in paragraphs (d)(1)(i) and (ii) of this section shall be used within the allowable range of SUL, OLE, and ARO for the appropriate Phase, as defined in the following table 7:

TABLE 7—ALLOWABLE RANGES OF SUL, OLE, AND ARO FOR THE NO_X EQUATIONS IN PARAGRAPHS/(D)(1)(I) AND (II) OF THIS SECTION

Fuel parameter	Phase I		Phase II	
	Low end	High end	Low end	High end
SUL	10.0	450.0	10.0	450.0
OLE	3.77	19.0	3.77	19.0
ARO	18.0	36.2	18.0	36.8

(B) For fuels with SUL, OLE, and/or ARO levels outside the ranges defined in table 7 of paragraph (d)(1)(iv)(A) of this section, $Y_{nox}(t)$ shall be defined as:

(*1*) For Phase I:

$$Y_{Nox}(t) = 100\% \times 0.82 \times [\exp(n_1(et)) / \exp(n_1(b))–1] + 100\% \times 0.18 \times [\exp(n_2(et))/\exp(n_2(b))–1] + \{100\% \times 0.82 \times [\exp(n_1(et)) / \exp(n_1(b))] \times [\{[(-0.00000133 \times SUL_{et}) + 0.000692] \times \Delta SUL\} + \{[(-0.000238 \times ARO_{et}) + 0.0083632] \times ARO\} + \{[(0.000733 \times OLE_{et}) - 0.002774] \times \Delta OLE\}]\} + \{100\% \times 0.18 \times [\exp(n_2(et)) / \exp(n_2(b))] \times [\{0.000252 \times \Delta SUL\} + \{[(-0.0001599 \times ARO_{et}) + 0.007097] \times \Delta ARO\} + \{[(0.000732 \times OLE_{et}) -0.00276] \times \Delta OLE\{]\}$$

(*2*) For Phase II:

(C) For both Phase I and Phase II, the ''edge target'' fuel is identical to the target fuel for all fuel parameters, with the following exceptions:

(*1*) If the sulfur level of the target fuel is less than 10 parts per million, then the value of SUL for the ''edge target'' fuel shall be set equal to 10 parts per million.

(*2*) If the sulfur level of the target fuel is greater than 450 parts per million, then the value of SUL for the ''edge target'' fuel shall be set equal to 450 parts per million.

(*3*) If the aromatics level of the target fuel is less than 18 volume percent, then the value of ARO for the ''edge target'' fuel shall be set equal to 18 volume percent.

(*4*) If the olefins level of the target fuel is greater than 19 volume percent, then the value of OLE for the ''edge target'' fuel shall be set equal to 19 volume percent.

(*5*) If the E300 level of the target fuel is greater than 95 volume percent, then the E300 value of the target fuel shall be set equal to 95 volume percent for the purposes of calculating NO_X emissions with the equations given in paragraph (d)(1)(iv)(B) of this section.

(*6*) If the sulfur level of the target fuel is less than 10 parts per million, then ΔSUL shall be set equal to (SUL − 10 parts per million).

(*7*) If the sulfur level of the target fuel is greater than 450 parts per million, then ΔSUL shall be set equal to (SUL − 450 parts per million).

(*8*) If the sulfur level of the target fuel is neither less than 10 parts per million nor greater than 450 parts per million, ΔSUL shall be set equal to zero.

(*9*) If the aromatics level of the target fuel is less than 18 volume percent and greater than 10 volume percent, then ΔARO shall be set equal to (ARO − 18 volume percent). If the aromatics level of the target fuel is less than 10 volume percent, then ΔARO shall be set equal to −8 volume percent.

(*10*) If the aromatics level of the target fuel is greater than or equal to 18 volume percent, then ΔARO shall be set equal to zero.

(*11*) If the olefins level of the target fuel is greater than 19 volume percent, then ΔOLE shall be set equal to (OLE − 19 volume percent).

(*12*) If the olefins level of the target fuel is less than or equal to 19 volume percent, then ΔOLE shall be set equal to zero.

(2) The winter NO_X emissions performance of gasolines shall be given by the equations presented in paragraph (d)(1) of this section with the RVP value set to 8.7 psi.

(3) The NO_X emissions performance of the target fuel in percentage terms from baseline levels shall be given by the following equations:

For Phase I:

Summer NO_X% = [100% × (NO_X − 0.660 g/mi)]/(0.660 g/mi)

Winter NO_X% = [100% × (NO_X − 0.750 g/mi)]/(0.750 g/mi)

For Phase II:

Summer NO_X% = [100% × (NO_X − 1.340 g/mi)]/(1.340 g/mi)

Winter NO_X% = [100% × (NO_X − 1.540 g/mi)]/(1.540 g/mi)

Summer NO_X% = Percentage change in NO_X emissions from summer baseline levels

Winter NO_X% = Percentage change in NO_X emissions from winter baseline levels

(e) *Toxics performance*—(1) *Summer toxics performance.* (i) Summer toxic emissions performance of gasolines in VOC Control Regions 1 and 2 shall be given by the following equations:

TOXICS1 = EXHBZ + FORM + ACET + BUTA + POM + NEBZ1

TOXICS2 = EXHBZ + FORM + ACET + BUTA + POM + NEBZ2

where

TOXICS1 = Summer toxics performance in VOC Control Region 1 in terms of milligrams per mile.

TOXICS2 = Summer toxics performance in VOC Control Region 2 in terms of milligrams per mile.

EXHBZ = Exhaust emissions of benzene in terms of milligrams per mile, as determined in paragraph (e)(4) of this section.

FORM = Emissions of formaldehyde in terms of milligrams per mile, as determined in paragraph (e)(5) of this section.

ACET = Emissions of acetaldehyde in terms of milligrams per mile, as determined in paragraph (e)(6) of this section.

BUTA = Emissions of 1,3-butadiene in terms of milligrams per mile, as determined in paragraph (e)(7) of this section.

POM = Polycyclic organic matter emissions in terms of milligrams per mile, as determined in paragraph (e)(8) of this section.

NEBZ1 = Nonexhaust emissions of benzene in VOC Control Region 1 in milligrams per mile, as determined in paragraph (e)(9) of this section.

NEBZ2 = Nonexhaust emissions of benzene in VOC Control Region 2 in milligrams per mile, as determined in paragraph (e)(10) of this section.

(ii) The percentage change in summer toxics performance in VOC Control Regions 1 and 2 shall be given by the following equations:

For Phase I:

TOXICS1% = [100% × (TOXICS1 − 48.61 mg/mi)]/(48.61 mg/mi)

TOXICS2% = [100% × (TOXICS2 − 47.58 mg/mi)] / (47.58 mg/mi)

For Phase II:

TOXICS1% = [100% × (TOXICS1 − 86.34 mg/mi)] / (86.34 mg/mi)

TOXICS2% = [100% × (TOXICS2 − 85.61 mg/mi)]/(85.61 mg/mi)

where

TOXICS1% = Percentage change in summer toxics emissions in VOC Control Region 1 from baseline levels.

TOXICS2% = Percentage change in summer toxics emissions in VOC Control Region 2 from baseline levels.

(2) *Winter toxics performance.* (i) Winter toxic emissions performance of gasolines in VOC Control Regions 1 and 2 shall be given by the following equation, evaluated with the RVP set at 8.7 psi:

TOXICW = [EXHBZ + FORM + ACET + BUTA + POM]

where

TOXICW = Winter toxics performance in VOC Control Regions 1 and 2 in terms of milligrams per mile.

EXHBZ = Exhaust emissions of benzene in terms of milligrams per mile, as determined in paragraph (e)(4) of this section.

FORM = Emissions of formaldehyde in terms of milligrams per mile, as determined in paragraph (e)(5) of this section.

ACET = Emissions of acetaldehyde in terms of milligrams per mile, as determined in paragraph (e)(6) of this section.

BUTA = Emissions of 1,3-butadiene in terms of milligrams per mile, as determined in paragraph (e)(7) of this section.

POM = Polycyclic organic matter emissions in terms of milligrams per mile, as determined in paragraph (e)(8) of this section.

(ii) The percentage change in winter toxics performance in VOC Control Regions 1 and 2 shall be given by the following equation:

For Phase I:

TOXICW% = [100%×(TOXICW − 58.36 mg/mi)] / (58.36 mg/mi)

For Phase II:

TOXICW% = [100%×(TOXICW − 120.55 mg/mi)] / (120.55 mg/mi)

where

TOXICW% = Percentage change in winter toxics emissions in VOC Control Regions 1 and 2 from baseline levels.

(3) The year-round toxics performance in VOC Control Regions 1 and 2 shall be derived from volume-weighted performances of individual batches of fuel as described in § 80.67(g).

(4) Exhaust benzene emissions shall be given by the following equation, subject to paragragh (e)(4)(iii) of this section:

$$EXHBZ = BENZ(b) + (BENZ(b) \times Y_{BEN}(t)/100)$$

$$Y_{BEN}(t) = \beta(w_1 \times N_b) + (w_2 \times H_b) - 1\alpha \times 100$$

where

EXHBZ = Exhaust benzene emissions in milligrams/mile

$Y_{BEN}(t)$ = Benzene performance of target fuel in terms of percentage change from baseline.

BENZ(b) = Baseline benzene emissions as defined in paragraph (b)(2) of this section for the appropriate phase and season.

$N_b = \exp b_1(t)/\exp b_1(b)$

$H_b = \exp b_2(t)/\exp b_2(b)$

w_1 = Weighting factor for normal emitters as defined in paragraph (b)(1) of this section for the appropriate Phase.

w_2 = Weighting factor for higher emitters as defined in paragraph (b)(1) of this section for the appropriate Phase.

$b_1(t)$ = Normal emitter benzene equation, as defined in paragraph (e)(4)(i) of this section, evaluated using the target fuel's properties subject to paragraph (e)(4)(iii) of this section.

$b_2(t)$ = Higher emitter benzene equation as defined in paragraph (e)(4)(ii) of this section, evaluated using the target fuel's properties subject to paragraph (e)(4)(iii) of this section.

$b_1(b)$ = Normal emitter benzene equation as defined in paragraph (e)(4)(i) of this section, evaluated for the base fuel's properties.

$b_2(b)$ = Higher emitter benzene equation, as defined in paragraph (e)(4)(ii) of this section, evaluated for the base fuel's properties.

(i) *Consolidated equation for normal emitters.*

$b_1 = (0.0006197 \times SUL) + (-0.003376 \times E200) + (0.0265500 \times ARO) + (0.2223900 \times BEN)$

(ii) *Equation for higher emitters.*

$b_2 = (-0.096047 \times OXY) + (0.0003370 \times SUL) + (0.0112510 \times E300) + (0.0118820 \times ARO) + (0.2223180 \times BEN)$

(iii) If the aromatics value of the target fuel is less than 10 volume percent, then an aromatics value of 10 volume percent shall be used when evaluating the equations given in paragraphs (e)(4) (i) and (ii) of this section. If the E300 value of the target fuel is greater than 95 volume percent, then an E300 value of 95 volume percent shall be used when evaluating the equations in paragraphs (e)(4)(i) and (ii) of this section.

(5) Formaldehyde mass emissions shall be given by the following equation, subject to paragraphs (e)(5) (iii) and (iv) of this section:

$FORM = FORM(b) + (FORM(b) \times Y_{FORM}(t) / 100)$

$Y_{FORM}(t) = [(w_1 \times N_f) + (w_2 \times H_f) - 1] \times 100$

where

FORM = Exhaust formaldehyde emissions in terms of milligrams/mile.

$Y_{FORM}(t)$ = Formaldehyde performance of target fuel in terms of percentage change from baseline.

FORM(b) = Baseline formaldehyde emissions as defined in paragraph (b)(2) of this section for the appropriate Phase and season.

$N_f = \exp f_1(t)/\exp f_1(b)$

$H_f = \exp f_2(t)/\exp f_2(b)$

w_1 = Weighting factor for normal emitters as defined in paragraph (b)(1) of this section for the appropriate Phase.

w_2 = Weighting factor for higher emitters as defined in paragraph (b)(1) of this section for the appropriate Phase.

$f_1(t)$ = Normal emitter formaldehyde equation as defined in paragraph (e)(5)(i) of this section, evaluated using the target fuel's properties subject to paragraphs (e)(5) (iii) and (iv) of this section.

$f_2(t)$ = Higher emitter formaldehyde equation as defined in paragraph (e)(5)(ii) of this section, evaluated using the target fuel's properties subject to paragraphs (e)(5) (iii) and (iv) of this section.

$f_1(b)$ = Normal emitter formaldehyde equation as defined in paragraph (e)(5)(i) of this section, evaluated for the base fuel's properties.

$f_2(b)$ = Higher emitter formaldehyde equation as defined in paragraph (e)(5)(ii) of this section, evaluated for the base fuel's properties.

(i) *Consolidated equation for normal emitters.*

$f_1 = (-0.010226 \times E300) + (-0.007166 \times ARO) + (0.0462131 \times MTB)$

(ii) *Equation for higher emitters.*

$f_2 = (-0.010226 \times E300) + (-0.007166 \times ARO) + (-0.031352 \times OLE) + (0.0462131 \times MTB)$

(iii) If the aromatics value of the target fuel is less than 10 volume percent, then an aromatics value of 10 volume percent shall be used when evaluating the equations given in paragraphs (e)(5) (i) and (ii) of this section. If the E300 value of the target fuel is greater than 95 volume percent, then an E300 value of 95 volume percent shall be used when evaluating the equations given in paragraphs (e)(5) (i) and (ii) of this section.

(iv) When calculating formaldehyde emissions and emissions performance, oxygen in the form of alcohols which are more complex or have higher molecular weights than ethanol shall be evaluated as if it were in the form of ethanol. Oxygen in the form of methyl ethers other than TAME and MTBE shall be evaluated as if it were in the form of MTBE. Oxygen in the form of ethyl ethers other than ETBE shall be evaluated as if it were in the form of ETBE. Oxygen in the form of non-methyl, non-ethyl ethers shall be evaluated as if it were in the form of ETBE. Oxygen in the form of methanol or non-alcohol, non-ether oxygenates shall not be evaluated with the Complex Model, but instead must be evaluated through vehicle testing per § 80.48.

(6) Acetaldehyde mass emissions shall be given by the following equation, subject to paragraphs (e)(6) (iii) and (iv) of this section:

$ACET = ACET(b) + (ACET(b) \times Y_{ACET}(t)/100)$

$Y_{ACET}(t) = [(w_1 \times N_a) + (w_2 \times H_a) - 1] \times 100$

where

ACET = Exhaust acetaldehyde emissions in terms of milligrams/mile

$Y_{ACET}(t)$ = Acetaldehyde performance of target fuel in terms of percentage change from baseline

ACET(b) = Baseline acetaldehyde emissions as defined in paragraph (b)(2) of this section for the appropriate phase and season

$N_a = \exp a_1(t)/\exp a_1(b)$

$H_a = \exp a_2(t)/\exp a_2(b)$

w_1 = Weighting factor for normal emitters as defined in paragraph (b)(1) of this section for the appropriate phase

w_2 = Weighting factor for higher emitters as defined in paragraph (b)(1) of this section for the appropriate phase

$a_1(t)$ = Normal emitter acetaldehyde equation as defined in paragraph (e)(6)(i) of this section, evaluated using the target fuel's properties, subject to paragraphs (e)(6) (iii) and (iv) of this section

$a_2(t)$ = Higher emitter acetaldehyde equation as defined in paragraph (e)(6)(ii) of this section, evaluated using the target fuel's properties, subject to paragraphs (e)(6) (iii) and (iv) of this section

$a_1(b)$ = Normal emitter acetaldehyde equation as defined in paragraph (e)(6)(i) of this section, evaluated for the base fuel's properties

$f_2(b)$ = Higher emitter acetaldehyde equation as defined in paragraph (e)(6)(ii) of this section, evaluated for the base fuel's properties

(i) *Consolidated equation for normal emitters.*

$$a_1 = (0.0002631\times SUL) + (0.0397860\times RVP) + (-0.012172\times E300) + (-0.005525\times ARO) + (-0.009594\times MTB) + (0.3165800\times ETB) + (0.2492500\times ETH)$$

(ii) *Equation for higher emitters.*

$$a_2 = (0.0002627\times SUL) + (-0.012157\times E300) + (-0.005548\times ARO) + (-0.055980\times MTB) + (0.3164665\times ETB) + (0.2493259\times ETH)$$

(iii) If the aromatics value of the target fuel is less than 10 volume percent, then an aromatics value of 10 volume percent shall be used when evaluating the equations given in paragraphs (e)(6) (i) and (ii) of this section. If the E300 value of the target fuel is greater than 95 volume percent, then an E300 value of 95 volume percent shall be used when evaluating the equations given in paragraphs (e)(6) (i) and (ii) of this section.

(iv) When calculating acetaldehyde emissions and emissions performance, oxygen in the form of alcohols which are more complex or have higher molecular weights than ethanol shall be evaluated as if it were in the form of ethanol. Oxygen in the form of methyl ethers other than TAME and MTBE shall be evaluated as if it were in the form of MTBE. Oxygen in the form of ethyl ethers other than ETBE shall be evaluated as if it were in the form of ETBE. Oxygen in the form of non-methyl, non-ethyl ethers shall be evaluated as if it were in the form of ETBE. Oxygen in the form of methanol or non-alcohol, non-ether oxygenates shall not be evaluated with the Complex Model, but instead must be evaluated through vehicle testing per § 80.48.

(7) 1,3-butadiene mass emissions shall be given by the following equations, subject to paragraph (e)(7)(iii) of this section:

$$BUTA = BUTA(b) + (BUTA(b)\times Y_{BUTA}(t)/100)$$

$$Y_{BUTA}(t) = [(w_1\times N_d) + (w_2\times H_d) - 1]\times 100$$

where

BUTA = Exhaust 1,3-butadiene emissions in terms of milligrams/mile

$Y_{BUTA}(t)$ = 1,3-butadiene performance of target fuel in terms of percentage change from baseline

BUTA(b) = Baseline 1,3-butadiene emissions as defined in paragraph (b)(2) of this section for the appropriate phase and season

$N_d = \exp d_1(t)/\exp d_1(b)$

$H_d = \exp d_2(t)/\exp d_2(b)$

w_1 = eighting factor for normal emitters as defined in paragraph (b)(1) of this section for the appropriate phase

w_2 = Weighting factor for higher emitters as defined in paragraph (b)(1) of this section for the appropriate Phase.

$d_1(t)$ = Normal emitter 1,3-butadiene equation as defined in paragraph (e)(7)(i) of this section, evaluated using the target fuel's properties, subject to paragraph (e)(7)(iii) of this section.

$d_2(t)$ = Higher emitter 1,3-butadiene equation as defined in paragraph (e)(7)(ii) of this section, evaluated using the target fuel's properties, subject to paragraph (e)(7)(iii) of this section.

$d_1(b)$ = Normal emitter 1,3-butadiene equation as defined in paragraph (e)(7)(i) of this section, evaluated for the base fuel's properties.

$d_2(b)$ = Higher emitter 1,3-butadiene equation as defined in paragraph (e)(7)(ii) of this section, evaluated for the base fuel's properties.

(i) *Consolidated equation for normal emitters.*

$$d_1 = (0.0001552\times SUL) + (-0.007253\times E200) + (-0.014866\times E300) + (-0.004005\times ARO) + (0.0282350\times OLE)$$

(ii) *Equation for higher emitters.*

$d_2 = (-0.060771 \times OXY) + (-0.007311 \times E200) + (-0.008058 \times E300) + (-0.004005 \times ARO) + (0.0436960 \times OLE)$

(iii) If the aromatics value of the target fuel is less than 10 volume percent, then an aromatics value of 10 volume percent shall be used when evaluating the equations given in paragraphs (e)(7)(i) and (ii) of this section. If the E300 value of the target fuel is greater than 95 volume percent, then an E300 value of 95 volume percent shall be used when evaluating the equations given in paragraphs (e)(7) (i) and (ii) of this section.

(8) Polycyclic organic matter mass emissions shall be given by the following equation:

$POM = 0.003355 \times VOCE$

POM = Polycyclic organic matter emissions in terms of milligrams per mile

VOCE = Non-methane, non-ethane exhaust emissions of volatile organic compounds in grams per mile.

(9) Nonexhaust benzene emissions in VOC Control Region 1 shall be given by the following equations for both Phase I and Phase II:

$NEBZ1 = DIBZ1 + HSBZ1 + RLBZ1 + RFBZ1$

$HSBZ1 = 10 \times BEN \times VOCHS1 \times [(-0.0342 \times MTB) + (-0.080274 \times RVP) + 1.4448]$

$DIBZ1 = 10 \times BEN \times VOCD11 \times [(-0.0290 \times MTB) + (-0.080274 \times RVP) + 1.3758]$

$RLBZ1 = 10 \times BEN \times VOCRL1 \times [(-0.0342 \times MTB) + (-0.080274 \times RVP) + 1.4448]$

$RFBZ1 = 10 \times BEN \times VOCRF1 \times [(-0.0296 \times MTB) + (-0.081507 \times RVP) + 1.3972$

where

NEBZ1 = Nonexhaust emissions of volatile organic compounds in VOC Control Region 1 in milligrams per mile.

DIBZ1 = Diurnal emissions of volatile organic compounds in VOC Control Region 1 in milligrams per mile.

HSBZ1 = Hot soak emissions of volatile organic compounds in VOC Control Region 1 in milligrams per mile.

RLBZ1 = Running loss emissions of volatile organic compounds in VOC Control Region 1 in milligrams per mile.

RFBZ1 = Refueling emissions of volatile organic compounds in VOC Control Region 1 in grams per mile.

VOCDI1 = Diurnal emissions of volatile organic compounds in VOC Control Region 1 in milligrams per mile, as determined in paragraph (c)(3) of this section.

VOCHS1 = Hot soak emissions of volatile organic compounds in VOC Control Region 1 in milligrams per mile, as determined in paragraph (c)(3) of this section.

VOCRL1 = Running loss emissions of volatile organic compounds in VOC Control Region 1 in milligrams per mile, as determined in paragraph (c)(3) of this section.

VOCRF1 = Refueling emissions of volatile organic compounds in VOC Control Region 1 in milligrams per mile, as determined in paragraph (c)(3) of this section.

(10) Nonexhaust benzene emissions in VOC Control Region 2 shall be given by the following equations for both Phase I and Phase II:

$NEBZ2 = DIBZ2 + HSBZ2 + RLBZ2 + RFBZ2$

$HSBZ2 = 10 \times BEN \times VOCHS2 \times [(-0.0342 \times MTB) + (-0.080274 \times RVP) + 1.4448]$

$DIBZ2 = 10 \times BEN \times VOCD12 \times [(-0.0290 \times MTB) + (-0.080274 \times RVP) + 1.3758]$

$RLBZ2 = 10 \times BEN \times VOCRL2 \times [(-0.0342 \times MTB) + (-0.080274 \times RVP) + 1.4448]$

$RFBZ2 = 10 \times BEN \times VOCRF2 \times [(-0.0296 \times MTB) + (-0.081507 \times RVP) + 1.3972$

where

NEBZ2 = Nonexhaust emissions of volatile organic compounds in VOC Control Region 2 in milligrams per mile.

DIBZ2 = Diurnal emissions of volatile organic compounds in VOC Control Region 2 in milligrams per mile.

HSBZ2 = Hot soak emissions of volatile organic compounds in VOC Control Region 2 in milligrams per mile.

RLBZ2 = Running loss emissions of volatile organic compounds in VOC Control Region 2 in milligrams per mile.

RFBZ2 = Refueling emissions of volatile organic compounds in VOC Control Region 2 in grams per mile.

VOCDI2 = Diurnal emissions of volatile organic compounds in VOC Control Region 2 in milligrams per mile, as determined in paragraph (c)(4) of this section.

VOCHS2 = Hot soak emissions of volatile organic compounds in VOC Control Region 2 in milligrams per mile, as determined in paragraph (c)(4) of this section.

VOCRL2 = Running loss emissions of volatile organic compounds in VOC Control Region 2 in milligrams per mile, as determined in paragraph (c)(4) of this section.

VOCRF2 = Refueling emissions of volatile organic compounds in VOC Control Region 2 in milligrams per mile, as determined in paragraph (c)(4) of this section.

(f) *Limits of the model.* (1) The equations described in paragraphs (c), (d), and (e) of this section shall be valid only for fuels with fuel properties that fall in the following ranges for reformulated gasolines and conventional gasolines:

(i) For reformulated gasolines:

Fuel property	Acceptable range
Oxygen	0.0–4.0 weight percent.
Sulfur	0.0–500.0 parts per million by weight.
RVP	6.4–10.0 pounds per square inch.
E200	30.0–70.0 percent evaporated.
E300	70.0–100.0 percent evaporated.
Aromatics	0.0–50.0 volume percent.
Olefins	0.0–25.0 volume percent.
Benzene	0.0–2.0 volume percent.

(ii) For conventional gasoline:

Fuel property	Acceptable range
Oxygen	0.00–4.0 weight percent.
Sulfur	0.0–1000.0 parts per million by weight.
RVP	6.4–11.0 pounds per square inch.
E200	30.0–70.0 evaporated percent.
E300	70.0–100.0 evaporated percent.
Aromatics	0.0–55.0 volume percent.
Olefins	0.0–30.0 volume percent.
Benzene	0.0–4.9 volume percent.

(2) Fuels with one or more properties that do not fall within the ranges described in above shall not be certified or evaluated for their emissions performance using the complex emissions model described in paragraphs (c), (d), and (e) of this section.

[59 FR 7813, Feb. 16, 1994, as amended at 59 FR 36959, July 20, 1994; 62 FR 68206, Dec. 31, 1997]

§ 80.46 Measurement of reformulated gasoline fuel parameters.

(a) *Sulfur.* Sulfur content shall be determined using American Society for Testing and Materials (ASTM) standard method D–2622–92, entitled ''Standard Test Method for Sulfur in Petroleum Products by X-Ray Spectrometry.''

(b) *Olefins.* Olefin content shall be determined using ASTM standard method D–1319–93, entitled ''Standard Test Method for Hydrocarbon Types in Liquid Petroleum Products by Fluorescent Indicator Adsorption.''

(c) *Reid vapor pressure (RVP).* Reid Vapor Pressure (RVP) shall be determined using the procedure described in 40 CFR part 80, appendix E, Method 3.

(d) *Distillation.* (1) Distillation parameters shall be determined using ASTM standard method D–86–90, entitled ''Standard Test Method for Distillation of Petroleum Products''; except that

(2) The figures for repeatability and reproducibility given in degrees Fahrenheit in table 9 in the ASTM method are incorrect, and shall not be used.

(e) *Benzene.* (1) Benzene content shall be determined using ASTM standard method D–3606–92, entitled ''Standard Test Method for Determination of Benzene and Toluene in Finished Motor and Aviation Gasoline by Gas Chromatography''; except that

(2) Instrument parameters must be adjusted to ensure complete resolution of the benzene, ethanol and methanol peaks because ethanol and methanol may cause interference with ASTM standard method D–3606–92 when present.

(f) *Aromatics.* Aromatics content shall be determined by gas chromatography identifying and quantifying each aromatic compound as set forth in paragraph (f)(1) of this section.

(1)(i) *Detector.* The detector is an atomic mass spectrometer detector (MSD). The detector may be set for either selective ion or scan mode.

(ii) *Method A.* (A) The initial study of this method used a three component internal standard using the following calculations.

(B) The calibration points are constructed by calculating an amount ratio and response ratio for each level of a particular peak in the instrument's calibration table.

(C) The amount ratio is the amount of the compound divided by the amount of the internal standard for a given level.

(D) The response ratio is the response of the compound divided by the response of the internal standard at this level.

(E) The equation for the curve through the calibration points is calculated using the type fit and origin handling specified in the instrument's calibration table. In the initial study the fit was a second degree polynomial including a forced zero for the origin.

(F) The response of the compound in a sample is divided by the response of